U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN No. 84.

Experiment Station Work,

VII.

HOME-MIXED FERTILIZERS.
FORCING ASPARAGUS IN THE FIELD.
FIELD SELECTION OF SEED.
POTATOES AS FOOD FOR MAN.
CORN STOVER AS A FEEDING STUFF.
FEEDING VALUE OF SUGAR BEETS.
SALT-MARSH HAY.
FORAGE CROPS FOR PIGS.
GROUND GRAIN FOR CHICKS.
SKIM MILK FOR YOUNG CHICKENS.
BY-PRODUCTS OF THE DAIRY.
STRIPPER BUTTER.
CURD TEST IN CHEESE MAKING.
GAPE DISEASE OF CHICKENS.

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II. (Farmers' Bul. 65).—Common Crops for Forage; Stock Melons; Starch in Potatoes; Crimson Clover; Geese for Profit; Cross Pollination; A Germ Fertilizer; Lime as a Fertilizer; Are Ashes Economical? Mixing Fertilizers.

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V. (Farmers' Bul. 78).—Humus in Soils; Swamp, Marsh, or Muck Soils; Rape; Velvet Bean; Sunflowers; Winter Protection of Peach Trees; Subwatering in Greenhouses; Bacterial Diseases of Plants; Grape Juice and Sweet Cider.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., September 30, 1898.

SIR: The seventh number of Experiment Station Work, prepared under my direction, is transmitted herewith with the recommendation that it be published as a Farmers' Bulletin.

Respectfully,

A. C. TRUE,
Director.

Hon. JAMES WILSON,
Secretary of Agriculture.

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EXPERIMENT STATION WORK—VII.[1]

HOME-MIXED V. FACTORY-MIXED FERTILIZERS.

It has been shown in a previous bulletin of this series (Farmers' Bul. 65) from the work of various experiment stations that it is perfectly practicable for farmers to buy unmixed fertilizing materials and prepare their own fertilizer mixtures, and that by so doing they may materially reduce the cost of their fertilizers.

Various objections have been raised to the practice of home-mixing.

Farmers are persuaded that the compounding of fertilizers is an intricate and difficult operation, requiring extensive acquaintance with chemistry, costly machinery, and great technical skill.

The case well illustrates the old adage, that a half truth is a whole falsehood. The production and manufacture of fertilizing materials—that is, the selection, quarrying, grinding, and acidulation of phosphatic rock; the drying and grinding of slaughterhouse refuse, the production and refining of such materials as nitrate of soda, sulphate of ammonia, and muriate of potash—all these are distinctly manufacturing processes which require chemical or technical knowledge, skill in manipulation, and expensive machinery. But these operations are entirely separate and distinct from the compounding of mixed fertilizers. Each of the materials named comes from the manufacturer in condition to be used by itself as a fertilizer and each one is so used for special purposes. The compounding of these materials under a proprietary brand into a mixed fertilizer is no more a manufacture than is the mixing of a ration of corn meal and bran to be fed to a cow. The only difference is that the ration which is designed to be distributed uniformly to thousands or millions of plants requires to be more carefully mixed than that fed to a single cow. If we were feeding each plant by itself no mixing would be necessary, or if we were giving the different elements of a ration at different times; as for instance, when we apply superphosphate and muriate of potash to wheat in the fall and follow with nitrate of soda in the spring.

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[1] This is the seventh number of a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. The chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations, and thus to acquaint our farmers in a general way with the progress of agricultural investigation on its practical side. The results herein reported should for the most part be regarded as tentative and suggestive rather than conclusive. Further experiments may modify them, and experience alone can show how far they will be useful in actual practice. The work of the stations must not be depended upon to produce "rules for farming." How to apply the results of experiments to his own conditions will ever remain the problem of the individual farmer.—A. C. True, Director, Office of Experiment Stations.

This point, of the essential difference between those operations which are legitimately called manufacturing and those which are simply mixing, should be clearly understood.

When the farmer learns that he can mix his own fertilizers and thereby materially reduce their cost the use of fertilizing materials will be largely increased, and the final outcome will be a benefit and not an injury to the legitimate trade in fertilizers.[1]

In order to determine whether fertilizers so mixed are any less effective than factory-mixed goods, the Ohio Station began in 1897 an experiment in which a few standard brands of factory-mixed fertilizers are being compared with home mixtures of tankage, acid phosphate, and muriate of potash, containing as nearly as possible the same amounts of potash, phosphoric acid, and nitrogen claimed for the factory-mixed goods. The experiments were located on heavy white-clay soil, and a rotation has been planned to include the three crops, corn, wheat, and clover, to follow each other in a three-year course, the fertilizers being applied to the corn and wheat. Up to the present, only the results with corn have been reported. These show that the home-mixed fertilizers gave yields fully equal to those produced by the factory-mixed goods. Basing the cost of the factory-mixed fertilizers upon what the station paid for them in small lots (200-pound sacks) at the factory and the cost of the home mixtures at the regular retail market price of the materials in single-sack lots, with freight to the station added, the saving on the home-mixed fertilizers was from $6 to $12 per ton.

Acting under the advice of the station a company of farmers bought several carloads of fertilizing materials and mixed for themselves last fall. These farmers first obtained propositions to furnish the desired materials from a considerable number of manufacturers and dealers. Selecting those which offered the best terms they concluded their purchase, the materials being guaranteed to carry a definite percentage of the required fertilizing elements. The materials, when received, were mixed according to formulæ furnished by the station, and the result of their use, as shown in the fall growth of the wheat to which they were applied, a few samples of factory-mixed fertilizers of similar composition being used alongside has been such as to lead to much larger purchases for this season's operations. The final cost of their lot of fertilizer, including cost of materials, freight, and mixing, was less by more than $500 than the lowest price at which the company was offered an equal quantity of factory-mixed fertilizers of equivalent composition and on the same terms of payment.

FORCING ASPARAGUS IN THE FIELD.

Asparagus is commonly forced by transplanting mature roots to some warm place, as in hotbeds or under greenhouse benches. Strong plants four or five years old are removed from the field late in the fall with as little damage to them as possible and stored in a cold place until wanted for forcing, when they are set close together in the beds prepared for them and covered with several inches of soil. In about two weeks cuttings can be made, and the plants will continue to yield for about six weeks. Since forced plants do not grow by becoming rooted in the

[1] Ohio Sta. Bul. 93.

soil, but are produced from material stored up in the roots the previous summer, when this reserve material is exhausted the roots must be thrown away and replaced by others. It will, therefore, be seen that this is rather a wasteful and expensive method of forcing asparagus.

To overcome this difficulty various means have been devised to force asparagus in the field, where it is so well established that it continues growth in the summer as though it had not been forced the previous winter. A simple and rather common method of accomplishing this is to place barrels or half barrels over clumps of asparagus very early in the spring and pile fermenting manure about them, the warmth from the manure forcing the shoots into rapid growth. When the forcing season is over and danger from frosts is past, the barrels are removed and the plants continue growth in the open air. Sometimes asparagus is forced by placing frames covered with sash over the plants in the field, the rows of asparagus being set rather close together. This is considered a very profitable method by many market gardeners. Another method of forcing asparagus in the field is to dig ditches between the rows and fill them with fermenting manure. The surface of the bed may also be mulched with manure. Sometimes brick tunnels are laid between the rows and hot-water pipes placed inside them to furnish the heat.

A method has been devised and used at Cornell University by which asparagus is grown in a house, the roof of which is removed in summer. The frame for a house 20 by 50 feet consists of a ridge and three pairs of rafters of gas pipe, over which canvas or muslin is stretched to form a roof. The walls are but 18 inches high. The heat is furnished by steam carried in one supply pipe near the ridge and two return pipes on either side of the house. By this method plants are easily forced into growth in January or February.

Another method of forcing asparagus in the field has recently been reported by the Missouri Station. The method is as follows: Trenches are made by running a plow twice in a place between the rows so as to throw the soil onto them. The trenches are then made uniform by means of a spade. When finished they are 3 or 4 inches lower than the crown of the plants. They are covered with 12-inch boards resting on 4-inch blocks on either side of the trenches, thus forming tunnels between the rows. The boards are covered with 2 or 3 inches of soil and over the whole bed 5 or 6 inches of horse manure is placed. Steam from the boiler is carried to the end of the central tunnel by a steam pipe and from there forced into the various tunnels through a steam hose. The steam comes into direct contact with the soil, penetrates it readily, and thereby warms the whole bed uniformly to the desired temperature, keeps the soil moist, and maintains a continuous fermentation of the manure mulch. About five minutes at a time was as long as steam could be forced into the tunnels without danger of injuring the plants.

This method was first tested at the station in the winter of 1896.

The field used had been planted to asparagus some ten years previous to the experiment. Six rows, 4 feet apart and 50 feet long, were prepared for forcing. Steam was first applied November 14. It was discharged in each tunnel not over five minutes at a time, about an hour being required to heat the bed to a temperatue of 60° F. After the first day the bed was steamed on an average of twice in three days and only for five minutes for each tunnel. The first asparagus was cut ten days after steaming was begun. It was as large as that ordinarily produced in spring and much more crisp. Cuttings were made almost daily for a month, when the growth became weak. The second test was begun December 16 and carried out as in the first test. The bed prepared for forcing was 25 by 75 feet. The first cutting was made two weeks after the first steaming. The time of cutting was more irregular than in the first test and was prolonged about two months. The weather being colder, somewhat more steam was required than in the first test. The plants forced were allowed to grow without cutting during the summer of 1897, and the spring growth of 1898 showed that one season's growth after forcing was sufficient for the plants to regain their normal vigor. In the winter of 1897–98 a test was made with a bed 25 feet square to determine the amount of coal necessary to force a given area of asparagus and the value of the product. The steam was first used December 29, the first asparagus was cut January 12, and cutting was continued until February 25. Steam was forced into the tunnels a total of 60¼ hours; 2,308 pounds of coal, valued at $1.82, was used in heating the bed. The yield was 162 bunches (80 pounds), valued at from 10 to 20 cents per bunch.

FIELD SELECTION OF SEED.

The improvement of cultivated plants is an all-important question in agriculture the world over and one which will disappear only with the vocation itself. Nearly two thousand years ago the Roman writers on agriculture recommended the careful selection of seed wheat, and it is not improbable that selection has been practiced from the remotest antiquity from which the cultivation of wheat dates. The wheats of ancient Egypt even were of excellent quality, and the limit of that degree of general development which can be attained by selection has, perhaps, been reached not only in wheat but in other ordinary farm crops. The principles of selection, however, must not be abandoned, but rather applied with precision to prevent degeneration and to preserve the high degree of development which has been reached through years of labor and care. The present condition of our grains does not preclude the possibility of establishing new varieties. Variations occur constantly in all crops, and the farmer, by heeding these hints of nature, may give permanence to a desirable quality which has shown itself in a single plant. The improvement of some plants, as the sugar beet, for instance, is mainly the work of specialists, but the improvement of our common

crops may receive the attention of the farmer and result in profitable reimbursement for the time and labor expended. It is also probable that the question of varieties is worthy of a greater consideration than it ordinarily receives. In a variety test with wheat recently conducted at the Pennsylvania Station, the best yielding variety produced 13.44 bushels per acre more than the variety giving the smallest yield, the one producing a little over 45 per cent more than the other.

The variations in plants are not always desirable, for the degeneration or "running out" of a variety is a form of variation which must be guarded against at all times. The qualities usually sought after are increased size of the grain or kernel and the yield in general, and a preferable change in the color of the grain and the time of ripening. The hardiness of a variety also is of great importance and is a factor which should be carefully considered, especially in connection with the improvement of our winter wheats. We have a good example of this in the Dawson Golden Chaff Wheat, which is of rather recent origin and which has given some very gratifying results. A bulletin of the Michigan Station describes it as follows:

> This variety originated in 1885, one stool containing five stalks being found at harvest time in that year on a bare exposed hill in a field of White Clauson where the surrounding wheat had been winterkilled. The farm on which it originated is located about 2 miles west of Galt, Ontario, and was owned at the time by Robert Dawson, who discovered, propagated, and introduced this variety. * * * For two years it * * * stood at the head of the varieties tested in the cooperative experiments conducted by the Ontario Agricultural College * * * and for three years it * * * stood first among the fifty-three varieties of wheat grown for trial on the experimental grounds connected with that college. Over a large part of Ontario it had become the leading market variety, being in especial demand to mix in grinding with spring wheat from the Northwest, and sometimes bringing an advance over the market price for that purpose. * * * The special merits of this variety, aside from the color and quality of the grain, are its hardiness and stiffness of straw, adapting it to cultivation on low, black land where many varieties winterkill and where the White Clauson is inclined to lodge and fail to properly fill.

This promising variety was obtained by selection in the field. Ordinarily the farmer makes his selection of seeds of wheat, oats, barley, etc., by means of the fanning mill, and his seed corn is selected from the crib or at husking time. These methods are a step in the right direction, and undoubtedly much good has come from them, but they are at best incomplete. This selection disregards everything except the condition of the grain. In selecting seeds the individual plants which produce them should be taken into consideration as well as the quality of the seed itself. Even weak and poorly developed plants are able to produce some well-developed seeds. A small stalk of corn may produce a large ear, and a poor wheat plant may produce some large grains in a head incompletely filled. These facts present a strong argument in favor of field selection as the most logical method of selecting the seeds. The selection of seeds of wheat, oats, barley, rye,

etc., from the growing crops presents greater difficulties than the field selection of seed corn; still it is not beyond accomplishment. For the selection of seeds of small grain, Beseler, a German writer, recommends the gathering of the best-developed heads from plants typical of the variety. The heads are thrashed and the heaviest grain retained for seed. He advises to sow this selected seed on a special plat, in drills far enough apart to admit of cultivation, placing a few grains at intervals of 6 inches in the drill. When ripe the grain should be carefully thrashed, and again the best and heaviest grains selected for seed. In this way, it is believed, a variety may readily be improved and kept up to its standard of excellence. The New Mexico Station, in a bulletin on this subject, gives practically the same advice.

The most logical way of selecting seeds of wheat, oats, rye, and barley would be at time of ripening in the field, selecting the longest and best filled heads, containing the largest, plumpest, and heaviest grains which grow in short thick stalks. * * * Enough heads can be gathered in this way in a few hours to furnish seed to produce the following year sufficient seed to supply the wants of the average farmer. * * * The practice of selecting Indian corn from seed from the crib or at husking time * * * is not altogether to be commended. * * * The best method is to select the ears before the stalks are cut, choosing those with not less than two well-formed ears on a stalk, which should be of low growth and well furnished with leaves, and ears set low to the ground. The plants should be vigorous and healthy. The ears selected should combine early maturity and uniformity of ripening.

In connection with this the results of experiments with wheat to determine the influence of the selection of seed made at Göttingen, Germany, will be of interest. The results in this experiment indicate that seed from large heads selected for a number of years produced a greater total yield than seed selected from small heads. The thickness, length of the straw, and the length of the upper internode were found to be greater in the plants grown from seed taken from large heads, and the number of internodes was also somewhat greater. Seed taken from heavy-culmed plants produced a heavier, stronger, and somewhat longer straw than seed taken from thin-culmed plants; the number of internodes was also found to be hereditary. The progeny of five-noded plants produced a larger total crop, stronger and longer culms, and longer heads than the progeny of four-noded ones. The plants were grown in pots, and it was observed that where one plant was grown in a pot the plant had a smaller number of internodes than where eight plants were grown in a pot. It is concluded from this that growth in a well-lighted position favors the strengthening of the culm and reduces the number of internodes. The results of an experiment with rye carried out in Germany by Westermeier show that the color of the seed grain is a factor of considerable importance in determining the character of the product.

These and other experiments of similar nature all go to show that not only the size and character of the grain but the development and characteristics of the entire plant—leaf, stem, nodes, etc.—must be taken into account in the effort to improve varieties.

The experiments of Girard in France and of several of the experiment stations in this country have justified the usual practice of successful growers in carefully selecting seed potatoes. By selecting for several generations average-sized tubers from the best hills Girard effected a considerable improvement in productiveness. To ascertain the best hills by digging each is exceedingly laborious, but Girard found that the best hills in an evenly manured field containing only one variety were those in which the vines were most vigorous. Selection was thus rendered easy by means of stakes placed beside the luxuriant plants.

The North Dakota Station sums up three years' experiments along this line with potatoes as follows:

"Selection of large-size tubers from the general crop as stored in the bin will not, with any desired certainty, make the crop a better one; for some hills which naturally yield many tubers of off-form and small size may furnish a large number of the tubers for the next crop. * * * Selection should be done in the field at digging time, and should be made from those hills which produce potatoes of the form and character desired," taking into consideration not only the yield and character of the tubers but also the growth and vigor of the vines; i. e., "the entire aspect of the plant rather than the single feature desired."

POTATOES AS FOOD FOR MAN.

The potato is a staple article of diet in almost every household. The universality and extent of its consumption would seem sufficient to prove it to be a wholesome and nutritious food. The statement, however, is frequently met with in popular articles that potatoes are not a wholesome food. So far as can be learned this is a purely gratuitous assumption. While it is possible that there are persons with whom potatoes do not agree, or who for some reason are compelled to forego starchy foods, there is no reason to suppose that potatoes are not as a rule a useful and wholesome article of diet.

The most important groups of constituents in foods are protein (nitrogenous matter), fats, and carbohydrates (starches, sugars, etc.). The potato is essentially a starchy food, and eaten alone it would furnish a very one-sided, badly balanced diet, which would probably prove unwholesome to most people. When eaten with meat, eggs, fish, etc., which are essentially nitrogenous foods, an evenly balanced diet, which is most conducive to health and vigor, is secured. The table (p. 12) affords a means of comparing the composition of the edible portion of foods rich in carbohydrates, like potatoes, flour, and bread, with those rich in protein—beefsteak, codfish, etc.

Composition of potatoes compared with that of other common food products.

	Water.	Protein.	Carbohydrates.	Fat.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Potatoes	78.0	2.1	18.0	0.1	0.9
Flour	12.5	11.3	74.6	1.1	.5
Bread, white	35.4	0.5	52.8	1.2	1.1
Turnips	88.9	1.4	8.7	.2	.8
Cabbage	90.3	2.1	5.8	.4	1.4
Beefsteak, round	68.5	20.4	0.0	10.0	1.1
Fresh codfish	82.0	15.8	0.0	.4	1.2

As the table shows, the potato contains a high percentage of water, although not as much as turnips, cabbage, and similar foods. The greater part of the dry matter of potatoes is carbohydrates (principally starch).

Chemical analysis thus shows that the practice, which has become so general, of serving potatoes with meat and similar foods is based upon scientific principles, one food supplying the deficiencies of the other.

In experiments on the digestibility of potatoes by man, recently made at the Minnesota Experiment Station, it was found that 71.9 per cent of the protein and 93 per cent of the carbohydrates were digested or assimilated. In these experiments the potatoes were eaten with some eggs, milk, and cream, so that the conditions may be assumed to be about normal.

As was stated above, carbohydrates are an essential of a well regulated diet. The experiments just referred to show that potatoes properly cooked furnish such material in a digestible form. They have been a staple article of diet for many years without harmful results, and therefore the conclusion that under ordinary circumstances they are other than a useful and wholesome food seems unwarranted.

CORN STOVER AS A FEEDING STUFF.

The Maryland Experiment Station has published the results of some investigations which show anew the value of corn stover as a feeding stuff, provided it is prepared so it can be eaten by stock without waste or danger to health. This work takes up the matter from a new standpoint—that of feeding the stover cleaned of the pith. A large part of the bulk of cornstalks and about one-fifth of their weight is composed of pith. This is generally considered to be composed very largely of cellulose and to be of very little value for feeding. Recently a number of uses have been found for the pith in the arts, and a process has been patented and factories erected for the separation of the pith on a commercial scale. In this process the stover is dried, the blades and husks are removed, and the stalks are ground. The pith, being lighter than the rest of the cornstalk, is separated from it by winnowing. The remainder is used for feeding, and has been designated the "new corn product." It was this material which served for the investigation at the Maryland Station.

The composition of this material, as compared with that of corn fodder from which it was made, and of shredded corn is shown below:

Composition of new corn product, corn fodder, and shredded corn.

	Water.	Protein.	Fat.	Nitrogen-free extract.	Crude fiber.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
New corn product	9.22	6.38	2.84	48.86	28.70	4.00
Corn fodder	9.80	3.94	2.42	46.16	33.18	4.50
Shredded corn fodder	20.10	4.31	2.37	40.33	28.29	4.60

The new corn product and the corn fodder were both dried artificially, so that they contained considerably less water than is ordinarily present in corn fodder.

The digestibility of the new corn product was compared with that of ground corn fodder, shredded corn fodder, and corn blades (leaves) and husks. The corn fodder was ground so as to be in about the same mechanical condition as the new corn product. The materials were fed to steers, and the proportion of each constituent was found to be as follows:

Digestibility of new corn product, corn fodder, and corn blades.

	Dry matter.	Protein.	Fat.	Nitrogen-free extract.	Crude fiber.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
New corn product	63.5	59.7	82.8	65.8	60.5	48.7
Shredded corn fodder	58.6	38.2	73.2	57.3	67.1	29.3
Ground corn fodder	53.2	35.0	77.5	54.0	55.9	20.0
Corn blades and husks	64.0	47.7	58.1	66.4	72.9	22.6

It will be noticed that the new corn product was considerably more digestible than either shredded corn fodder, finely ground corn fodder, or corn blades and husks. As compared with the average figures for timothy hay when fed to cattle, the new corn product was found to be considerably more digestible than that material. The author says, "The results given in the above tables prove the new corn product to be a valuable cattle food, and in no sense should it be considered a waste product. The results not only show this material to be valuable, but in every respect show it to be superior to the shredded corn fodder or the entire plant in its natural condition."

The digestibility of the new corn product was also compared with that of timothy hay with horses. Here again the new corn product was found to be considerably more digestible.

A fattening experiment was made with steers, in which the new corn product was compared with corn blades, feeding a constant grain mixture with each. The steers on the new corn product gained 428 pounds in 60 days, or 3.57 pounds per head daily, while those on the corn blades gained 403 pounds, or an average of 3.36 pounds per head daily.

The new corn product was mixed with the grain. It was eaten with relish by the stock, and there was no waste. The cattle would lie down and chew their cud as naturally as when fed hay or in the pasture.

Later experiments were made with horses, in which the new corn product was compared with timothy hay, feeding ground oats in both cases. "Both rations maintained the animals in their normal condition, but there was considerably less eaten when on the new corn-product ration." This would be expected from the greater digestibility of the latter. Other trials were made in which the animals were worked. Here also it was found a satisfactory substitute for hay. In all, nine different horses were fed on rations with the new corn product. The author concludes that "the fact that the horses ate this feed continuously for five months and relished it more at the end than at the beginning, * * * together with the testimony of the weights, is sufficient data for concluding that the new corn product is a good food for horses and can replace hay for that purpose."

Satisfactory trials have also been made in feeding this material to cows and pigs. The animals take to it readily, seem fond of it, and eat it up clean without any waste.

Chemical analyses and digestion experiments made by the New York State Station go to show "that the new corn product has no materially increased value over well-cured and well-prepared corn fodder."

This work is interesting and useful, not only as showing the value of this particular new by-product of corn stover, but in a broader sense as indicating the great value of corn stover when it is rendered palatable to stock. It may be that the chief advantage of the new material lies in its mechanical condition, making it convenient to handle and to mix with other feed, and resulting in a more economical use of it by animals.

In feeding whole-corn fodder their is a large waste and the uneaten parts get into the manure and make it difficult to handle. The use of the corn shredder has removed these objections in large degree.

It is calculated from the statistical reports of this Department that the corn-stover crop of the United States in 1897 was nearly 80,000,000 tons, as compared with the hay crop of 60,665,000 tons. This corn stover would contain about 30,000,000 tons of food materials actually digestible by animals, including over 1,500,000 tons of protein, 27,000,000 tons of carbohydrates, and nearly 500,000 tons of fat. These figures are almost too large for comprehension. They mean that the corn-stover crop of the country contains nearly or quite as much digestible food materials as the hay crop. Throughout the corn-raising sections there is a very large and in some cases an almost total waste of this material. Anything, therefore, which will lead to a greater and more profitable utilization of corn stover will be of immense benefit to farmers in the corn-growing sections.

THE FEEDING VALUE OF SUGAR BEETS.

Sugar beets are being widely grown in the United States with a view to determining the localities in which they can be produced of sufficiently high quality to warrant the establishment of beet-sugar factories. It is not probable that factories will be built in all the localities where experiment shows that beets of high quality can be grown, and even in those localities where factories are established there will sometimes be a surplus of beets, which can not be disposed of to the factory. In such cases it is important to find some profitable use for the beets on the farm. Sugar beets, like other root crops, make an excellent addition to foods for cattle, sheep, and pigs. They are succulent and nutritious, keep well over winter, and form a welcome addition to the dry food of stock, keeping the animals in good health and maintaining the flow of milk.

The following table shows the food constituents in sugar beets as compared with other roots and with some of the more common feeding stuffs:

Food constituents of sugar beets and other feeding stuffs.

	Water.	Protein.	Fat.	Nitrogen-free extract.	Fiber.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Sugar beets	86.5	1.8	0.1	9.8	0.0	0.9
Turnips	00.5	1.1	.2	6.2	1.2	.8
Mangel-wurzels	00.9	1.4	.2	5.5	.9	1.1
Ruta-bagas	88.6	1.2	.2	7.5	1.3	1.2
Corn fodder (whole plant)	79.3	1.8	.5	12.2	5.0	1.2
Corn silage	79.1	1.7	.8	11.0	6.0	1.4
Timothy hay	13.2	5.0	2.5	45.0	29.0	4.4

This table shows that as far as chemical composition is concerned sugar beets are somewhat richer than other common root crops, although experiments have indicated that all the common root crops are equally valuable as food for animals if equally palatable. The beets are not so rich in total food constituents as green corn fodder and silage, but it must be borne in mind that the beets are practically completely digestible, while only from two-thirds to three-fourths of the dry matter of corn fodder and silage is digestible.

The feeding value of sugar beets has been demonstrated in experiments at many of the stations. At the Wyoming Station sugar beets and alfalfa hay and grain and alfalfa hay were compared during the winter on steers and sheep, with the result that the animals fed sugar beets and hay gave better returns than those fed grain and hay or hay alone. In these experiments the steers were fed 14 pounds of sugar beets per head per day and all the hay they would eat.

Sugar beets, if fed in excessive amounts, may induce scouring. Extended experiments in Denmark have indicated that roots of any kind should not constitute more than 40 per cent of the ration of pigs. It is probable that this proportion should not be exceeded with other animals, although larger proportions have been fed to cows without injurious

effects. Roots give best results when fed with grain or other concentrated food. As the above analyses show, beets contain little protein (nitrogenous matter). In order, therefore, to furnish a well-balanced ration they should be combined with some more nitrogenous food, such as wheat bran, peas, beans, oil meal, gluten meal, etc. The importance of thus providing a well-balanced ration was clearly demonstrated in the Wyoming Station experiments above referred to. In these experiments "the best balanced ration gave the best returns in each case."[1]

SALT-MARSH HAY.

In certain parts of the country, especially along the New England coast, there are extensive salt marshes which yield an abundant growth of the coarser grasses, locally known as "black grass, fox grass, branch grass, blue grass (variety of redtop), cove hay, salt hay mixture, and flat sage."[2] These grasses are cut and used as feed to a considerable extent in some localties, but no accurate experiments had been made to determine the actual feeding value of the different kinds of grasses until the Massachusetts Hatch Station undertook this work, although the Connecticut Station has made very complete chemical analyses of them.

In the experiments of the Massachusetts Station "the hays were analyzed, their digestibilities were determined by the aid of sheep, and their effects upon the quantity, as well as their influence upon the quality, of both milk and butter were carefully noted."

The following table shows the composition of different salt-marsh hays as compared with average meadow hay:

Composition of salt-marsh hays.

Kind of hay.	Water.	Protein	Fat.	Nitrogen-free extract.	Ash.	Potash.	Phosphoric acid.	Nitrogen.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Black grass (*Juncus gerardi*)	16.00	7.32	2.08	43.89	6.00	(*a*)	(*a*)	(*a*)
Fox grass (*Spartina patens*)	17.00	7.27	2.00	45.07	6.22	0.92	0.18	1.20
Branch grass (*Distichlis spicata*)	21.00	6.22	2.22	43.46	0.20	.85	.18	1.00
Cove mixture (redtop and black grass)	18.00	7.23	1.72	44.54	5.90	(*a*)	(*a*)	(*a*)
Salt-hay mixture (branch grass, fox grass, and flat sage)	10.00	5.44	2.10	45.57	8.40	(*a*)	(*a*)	(*a*)
Flat sage (*Spartina stricta maritima* var.?)	17.00	0.49	2.41	41.32	8.12	1.10	.31	1.00
Redtop (*Agrostis vulgaris*)	13.00	0.78	1.58	44.85	5.02	(*a*)	(*a*)	(*a*)
Average meadow hay of mixed grasses ("English" hay)	13.00	6.56	2.15	42.17	4.25	1.50	29	1.00

a Not determined.

The table shows that the salt-marsh hays differ but little in chemical composition from average meadow hay. They contain about the same amount of protein, less fiber, and a little more nitrogen-free extract

[1] For information regarding the compounding of rations for farm animals see Farmers' Bulletin No. 22 of this Department.

[2] For a discussion of the grasses of the salt marshes see Yearbook of this Department for 1895, p. 325.

(which consists principally of carbohydrates—starch, sugar, etc.). They also contain a little more ash, the excess of the latter being due to salt.

"The same amount of nitrogen was found as in English hay,[1] and two-thirds as much phosphoric acid and potash."

From the digestion experiments made by the station it was found that the following percentages of the different constituents of the various hays were digestible:

Coefficient of digestibility of salt-marsh hays.

Kind of hay.	Protein.	Fat.	Nitrogen-free extract.	Fiber.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Black grass (*Juncus gerardi*)	54	46	49	57
Fox grass (*Spartina patens*)	56	36	53	57
Branch grass (*Distichlis spicata*)	52	37	46	25
Cove mixture (redtop and black grass)	48	40	53	60
Salt-hay mixture (branch grass, fox grass, and flat sage)	42	28	52	58
Flat sage (*Spartina stricta maritima* var.?)	52	36	55	60
Redtop (*Agrostis vulgaris*)	37	49	46	56
Average meadow hay of mixed grasses ("English" hay)	54	46	56	58

Salt hay, cut when in blossom and well cured, contains rather less digestible matter than average English hay cut under similar conditions. * * * [It has] from 10 to 18 per cent less feeding value than average English hay.

When fed in combination with grain and corn silage * * * the salt-hay rations produced [as a rule] from 2 to 5 per cent less milk and butter than did an equal amount of English hay similarly combined. * * *

When fed directly after milking no objectionable flavor could be detected in the milk or butter. It is possible that if these hays were cut very soon after being covered by the tide they would then produce a disagreeable flavor. * * *

The salt-hay rations produced milk with a trifle less percentage of fat than did the English hay ration. The difference is so slight as to be of no practical importance.

Because of the lower market price for salt hays as compared with English hay, daily rations containing 10 to 12 pounds of salt hay produced milk and butter from 10 to 20 per cent cheaper than rations containing an equal amount of English hay.

When there is a good market for English hay it is undoubtedly wise to sell it and feed salt hay in combination with corn silage as a substitute. One bushel of corn silage and 12 pounds of salt hay make a good daily coarse-fodder ration. If corn silage is not at hand, equal amounts of salt and English or pea and oat hay can compose the roughage ration. Any of the following grain mixtures may be fed in connection with the coarse fodders for complete daily rations:

I.

50 pounds cotton-seed meal,
100 pounds gluten feed,
100 pounds corn meal.
Mix and feed 5 to 7 quarts daily.

II.

100 pounds gluten meal,
100 pounds wheat bran.
Mix and feed 8 to 9 quarts daily.

III.

50 pounds cotton-seed meal,
100 pounds gluten feed,
100 pounds wheat bran.
Mix and feed 7 to 9 quarts daily.

IV.

100 pounds corn meal,
75 pounds gluten or cotton-seed meal.
Mix and feed 5 to 6 quarts daily.

[1] Meadow hay, of mixed grasses.

The economy of the above different grain rations will depend on the local cost of the different feed stuffs.

It must be remembered that the value of salt hay is decidedly influenced by the time of cutting, and by the condition of the weather during the time of cutting and for a few weeks immediately after. A good deal of the salt hay cut would fall considerably below the value given it above because of late cutting and bad weather.

FORAGE CROPS FOR PIGS.

It is the opinion of many well-informed agriculturists that a much larger number of pigs may be profitably raised in the Southern States than is done at present. Generally speaking, there is an abundance of corn available; suitable forage crops are, however, required in addition. Peanuts and cowpeas furnish succulent food which contains considerable quantities of protein. While sweet potatoes contain only a small amount of protein, the content of carbohydrates is high and they may be easily raised, giving a comparatively certain and abundant crop.

Experiments were recently made at the Alabama College Station on the value of the above-named crops as food for pigs. Immediately after weaning, 6 Poland-China pigs were hurdled on a field of Spanish peanuts and given some shelled corn in addition. The peanuts were eaten readily, and as long as the vines remained green the leaves were eaten also. The yield of peanuts was at the rate of 62.6 bushels per acre. In the six weeks of the experiment the pigs consumed 373 pounds of shelled corn besides the peanuts and some foliage from 7,673 square feet, and gained 196.4 pounds—that is, 1.4 pounds of peanuts and 1.9 pounds of corn, together with an unknown quantity of peanut foliage, were consumed per pound of gain. Valuing the corn at 40 cents per bushel and pork at 3 cents per pound, the profit from the peanuts was at the rate of $18.34 per acre. The peanuts were raised on poor sandy upland which, in the investigator's opinion, would not have produced over 200 pounds of lint cotton per acre, worth from $10 to $12. The expense of cultivating the peanuts was less than for a similar area of cotton, and in addition the soil was benefited by the manure and the peanut vines.

Other tests were made, including one in which unhulled peanuts and corn meal were compared. When fed to pigs in pens only 2.8 pounds of unhulled Spanish peanuts were required to produce a pound of gain. In other words, there was a return of 9 pounds of pork, worth 27 cents, from a bushel of peanuts. The general conclusion was drawn that under ordinary circumstances an acre of peanuts supplemented by 37.8 bushels of corn produced 1,426 pounds of pork.

Young pigs pastured on nearly mature cowpeas and supplied with some corn in addition gained nearly three times as much in weight as similar pigs fed exclusively on corn. Deducting the value of the corn fed, the cowpeas returned in the form of pork $10.65 per acre.

Pigs confined in pens and fed ground cowpeas and corn gained more rapidly in weight than pigs fed corn alone. In effect 5.28 pounds of the mixed feed were equivalent to 8.06 pounds of corn alone.

Sweet potatoes and corn meal were also compared. Three pounds of sweet potatoes proved decidedly inferior to 1 pound of corn. It was calculated that in the form of pork the sweet potatoes returned only 13 cents per bushel.

This does not imply that sweet potatoes can not be profitably employed as food for pigs. But a profit is possible only by saving the expense of harvesting, the heaviest single item of expense in sweet-potato culture. If the pigs do the rooting the sweet potato is doubtless a cheaper food than corn on some sandy soils that yield ten to fifteen times as many bushels of sweet potatoes as of corn. The vines are also valuable as food for pigs.

The value of sweet potatoes will be enhanced by feeding with them a liberal allowance of cowpeas or peanuts, which supply the nitrogenous material in which the sweet potato is deficient.

The effect of the foods tested on the quality of the pork, more especially on the melting point of the lard, was noted. Cowpeas fed with corn had no injurious effect. Peanuts when fed with corn softened the pork and lard decidedly, and this effect was still more noticeable when the peanuts were fed alone. The softening effect of peanuts was not corrected by feeding corn exclusively for a month before slaughtering. The pork, however, had an unusually good flavor.

For the results of similar work elsewhere see Experiment Station Work—I (Farmers' Bul. 56 of the Department).

GROUND GRAIN V. WHOLE GRAIN FOR CHICKS.

The New York State Station has recently reported experiments made to determine whether it will pay to grind grain for poultry.

The first experiments were begun with two lots of 22 chicks each, one lot being fed "all its grain finely ground, the basis of the ration being a mixture of two parts by weight of corn meal, two parts wheat bran, and one part each of wheat middlings, old-process linseed meal, and ground oats. This was supplemented by skim milk, dried blood, and additional amounts daily of corn meal and ground oats. The grain fed [the other lot] was either whole or cracked and consisted of oats, wheat, corn, and barley. Skim milk, fresh-cut bone, and dried blood were fed in addition."

At the end of 12 weeks "the cockerels among these chicks were caponized and fed these contrasted rations during the winter, 12 capons in each lot being fed for 4 months and 8 continued nearly 7 months. * * * Two other lots of capons from chicks raised by hens and treated alike until caponized were fed these contrasted rations for about 5 months.

"The ground-grain ration proved considerably more profitable than the whole-grain ration with the growing chicks; and the same was true of capons of equal weight from these chicks and from others of equal weight and age fed alike before caponizing. No difference was noticed in health or vigor of chicks or capons fed either ration, but all made good gains and returned a fair margin of profit at the ordinary prices."

SKIM MILK FOR YOUNG CHICKENS.

Skim milk is a farm product whose food value is not fully appreciated. It is not generally realized that milk loses little in actual food value by skimming. It is true that most of the fat is removed in the cream, but the most valuable feed constituents—i. e., the nitrogenous substances—are left behind in the skim milk. Skim milk not only contains much nutritive material, but this material is in a form which is, as a rule, easily digested. It is not only healthful, nutritious food for man, but it may be fed to calves, pigs, and chickens with excellent results. Its composition is such that it may be substituted for part of the grain food, especially corn, of these animals with benefit and profit.

The Indiana Station has recently made some interesting experiments on the use of skim milk for young chickens. Two uniform lots (4 to 6 weeks old) of 10 chickens each (5 Plymouth Rocks and 5 Houdans) were fed from July 11 to September 5, under identical conditions except that one lot received in addition to the food given the other all the skim milk they would drink. "Both lots were given all they would eat of a mixed food consisting of two parts crushed corn, one part bran, and one part ground oats. They were fed three times a day, except on Sundays, when an increased amount of food was given at the morning and evening meal. * * * Both lots were also given all they would consume of cracked bone, cabbage, lettuce, and water of which no record was kept."

It was found that the lot receiving skim milk ate more of the mixed food and made a more rapid and satisfactory gain than the lot which did not receive skim milk. Milk-fed chickens made an average weekly gain of 4.46 ounces, those receiving no milk 2.62 ounces. The most rapid increase in weight occurred at those periods when the largest amounts of skim milk were consumed. The skim milk is considered "especially valuable as a food for young chickens during the hot dry weather and becomes of less importance as the chickens grow older and the weather becomes cooler."

The vessels in which the skim milk is fed should be scalded frequently to keep them clean and wholesome.

BY-PRODUCTS OF THE DAIRY.[1]

The profitable disposal of the by-products of the dairy, both at the factory and on the farm, is a matter worthy of the most serious consideration. Of these by-products skim milk is the most important, both on account of its abundance and its high feed value (see above). The Utah Station has recently published the results of some interesting experiments on the utilization of skim milk in the feeding of pigs and calves.

[1]For a full discussion of this subject see Yearbook of the Department for 1897, p. 509.

Feeding skim milk to pigs.—It is a common practice at creameries "to feed hogs on milk or whey alone, and where grain is fed it is given only to finish the hog for market. This method of management does not appear to be successful, for it generally takes the whole season to get one crop of hogs ready for the market; besides, in many instances, it results in too high a death rate among the hogs to be at all profitable."

In the station experiments with pigs, which extended over several years and covered all seasons of the year, a study was made of "the economy of feeding milk alone and milk in combination with grain as compared with feeding grain alone." The grain fed was barley and bran (half and half), followed by ground corn and wheat (one to one), in the first experiment; equal parts of wheat and bran in the second, third, and fourth; ground wheat in the fifth; and equal parts of bran and corn meal in the sixth and seventh. There was no attempt, however, "to compare the relative value of the different varieties of grain when fed in combination with milk."

When milk and grain were fed in combination the milk was mixed with the grain before feeding, making a slop. The milk fed was sometimes fresh and sometimes sour, but never old. It was found to be impossible to get uniformity in this matter. Practically, however, it will not vitiate the results; it may even add value to them, as it would approach nearer to what the farmers and dairymen have to feed. When the hogs were fed grain alone, water was added to make a slop of similar consistency to that given the hogs fed on milk and grain. The hogs at all times had access to pure water, and a supply of charcoal and ashes was always kept in the pens.

The results of the experiments clearly prove that skim milk when fed in combination with grain makes a very valuable food for hogs at all periods of their growth, but particularly so during the earlier stages. Thus combined it makes a much more economical ration for hogs than either milk alone or grain alone. When fed in combination with grain, skim milk had 63 per cent greater feeding value than it had when fed alone, 100 pounds of skim milk taking the place of 23.2 pounds of grain in the former case and 14.2 pounds in the latter. Not only was the gain greater but it was more rapid in case of hogs fed on the milk and grain ration than in case of either those fed on milk alone or on grain alone. The time required to make 100 pounds of gain was 79 days for the hogs fed on milk and grain, 116 days for those fed on grain alone, and 147 days when the food was milk alone. When the skim milk and grain were fed in the proportion of 3 pounds or less of skim milk to 1 pound of grain the return for the skim milk was greater than when a larger proportion was fed. Hogs fed on milk alone gained very slowly and did not keep in good health. In some cases they were off their feed so frequently that a change of feed had to be made. The milk-and-grain-fed hogs, however, without exception, kept in good health. Young hogs fed on grain alone did not do well and appeared to make poor use of the food they ate. Hogs did much better on milk alone or grain alone when on pasture than when similarly fed in small

pens. On the other hand, however, the hogs fed milk and grain in combination did better in the pens.

These experiments showed, further, that the appetite of the hogs and the palatability of the food seemed to have a very decided effect upon the rapidity and economy of the gain, "and that young hogs are in every way the more economical producers of pork. The hogs fed milk and grain required 62 per cent more to grow a pound of live weight when they weighed from 200 to 255 pounds than they did when they weighed from 38 to 100 pounds, and for those hogs fed grain alone the difference in favor of the smaller weight was 56 per cent."

Feeding skim milk to calves.—The experiments with calves at the Utah Station have likewise extended over several years (4).

The calves were in every case separated from the cow by the time they were twelve hours old. For the first 7 or 10 days the calves were fed the whole milk from the cow, some of the calves being fed twice and some three times a day. The milk was fed warm from the cow and the amount given was about 16 to 18 pounds per day. * * * When the calves were fed on whole milk it was gradually increased as they got older, till 20 to 22 pounds were fed per day at a month old, when the calves were disposed of.

Those calves which received skim milk were fed as follows: For the first 7 to 10 days of its life the calf got the whole milk from the cow; then skim milk was gradually substituted till at the end of one week, or when the calves were 14 to 17 days old, the calf got half skim milk and half whole milk. At the end of the next week the ration was three-fourths skim milk and one-fourth whole milk, and at the end of another week, or by the time the calf was 4 to 5½ weeks old, the ration consisted of all skim milk. If, however, the calf was not doing as well as we would like, a little whole milk was continued for another week or two. The amount of skim milk was gradually increased as the calf got older, but the most fed in any one day was from 25 to 27 pounds. The skim-milk ration was kept up till the calves were 5 to 6 months old, but as they increased in age they had what water they could drink in addition to the milk. We have found it to be of the utmost importance to make all changes of feed gradually, so as not to disturb the digestion of the young calf.

Separator skim milk was used, and in every instance it was fed fresh. To prevent the milk from souring, it was boiled by having steam turned into it (which diluted it about 8 per cent), and then it was cooled to about 60° F. in summer and to about 40° F. in winter. When treated in this way the milk would keep fresh about 3 or 4 days in summer and about a week during the winter.

The skim milk given to the young calves was always fed warm, from 80° to 100° F. The cold milk, we learned from a little experience, generally produced indigestion, with the resulting scours. The milk, however, should not be hot. Our method of warming the milk was by the use of a lamp stove, only a few minutes being required to heat a pailful of milk.

As soon as the calves would eat it, a little grain was given to them. Chopped grain was used, and it was fed dry in a box and not put into the milk. No tests were made of the value of the different kinds of grain, though quite a variety of grains was fed—wheat and bran, barley and bran, barley, peas and bran, corn and bran, and corn. No particular difference was noted in the efficacy of either. The calves usually started to eat a little grain when from 3 to 5 weeks of age. If, when first given to them, they did not eat the grain up clean, it was always renewed in 2 or 3 days. The cows or hogs never refused what the calves left.

After the calves were 2 or 3 weeks old a little hay—as a rule, lucern—was kept before them and renewed frequently; they soon learned to eat it.

By following the method above outlined, feeding the milk warm and not in too large quantities and making all changes of food gradually, we have managed to keep the calves in good health, and have been troubled but little with scours, which results from indigestion. The few cases that we have had yielded readily to treatment. A small handful of flour stirred in the milk we have found excellent as a corrective; or, better still, two teaspoonfuls of rennet extract in the milk for a few days. Our experience teaches that indigestion is something that must not be neglected or the calf may be permanently injured.

The results show that calves may be raised very profitably on skim milk when it is properly fed. While from the standpoint of gain in live weight and quality of meat whole milk is a better food for calves than skim milk, it makes too expensive a ration to be profitably fed. In these experiments the gain in live weight of the calves at 4 cents per pound returned only 10.7 cents per pound for the butter fat fed in the milk, and at 3 cents per pound only 8 cents per pound. While the calves whose rations were composed largely of skim milk gained one-half pound less per day than those fed on whole milk, they made practically the same gain in live weight per pound of dry matter consumed. In other words, they made just as good use of the food consumed.

The calves fed whole milk alone gave a greater proportion of dressed meat to live weight than did those fed on skim milk, and also gave more fat on the carcass.

Young calves up to 3½ months of age required less milk and less dry matter to each pound of gain than did the hogs. When the calves were 5 and 6 months old, however, more dry matter was required, but at least half of it was hay.

Fully as large financial returns were obtained for the skim milk when fed to calves as when fed to hogs. With the gain in live weight at 4 cents per pound the calves returned 22 cents per 100 pounds for the skim milk and the hogs 22.8 cents. If the gain in live weight was worth 3 cents per pound, the calves would return 5 cents per 100 pounds more for the milk than would the hogs.

In applying the above facts to actual farm practice it should not be forgotten that the results here given are probably the best that could be expected, while no account is taken of the cost of drawing the milk back to the farm, as would be necessary where the milk is sent to a factory, nor yet for caring for and feeding the hogs. As figured out under the best conditions, when a large number of hogs are handled, the labor cost of looking after them is about one-half cent for each 100 pounds of milk fed. On the farm, however, the cost, if it is reckoned at all, will be many times this, so that perhaps no more than one-half of the value here calculated could be given as the net returns for 100 pounds of skim milk. In handling a large number of hogs, too, it is doubtful if as good results would be obtained as there were with the small number fed at any one time in this experiment. However, our results show a possibility, and the above remarks in no way apply to or change the results obtained from a comparison of the different methods of feeding.

The remarks on the labor cost of feeding animals are equally as applicable to calf feeding as to hog feeding; though perhaps it would be more difficult to feed a large number of calves than a large number of hogs.

Another point to note is that the experiments answer only the question as to the value of the skim milk. Though whey was fed, our experiments were altogether too limited to compare its value with that of skim milk. Experiments conducted at other stations generally place the value of whey at one-half that of skim milk.

STRIPPER BUTTER.

The statement is often made, and recent experiments at the Oregon Station go to show, that cream rises imperfectly in milk from cows in advanced periods of lactation (stripper cows) and that it is difficult to obtain butter of good flavor from such milk.

The Iowa Station has investigated this subject, using milk from fresh cows and from those which had been in milk over six months (strippers). The milk from the two lots was creamed and churned separately. The results show that when the separator system was used the butter from the stripper milk was as good as that from the milk of the fresh cows.

Under a gravity system there may be some difference, as so many dairymen claim, and the following is a possible explanation: The fat globules, as is well known, are smaller in advanced periods of lactation, and when cream from such milk is raised by the gravity process more time is required for the cream to rise than when the milk is from fresh cows whose milk contains globules of much larger size. We have found that cream or milk when kept at a low temperature for some time develops a somewhat bitter flavor. There seems to be an organism which grows at that low temperature and which gives a flavor to the cream and to the butter. It is possible that this is why stripper milk is generally considered inferior for the production of butter.

As a means of overcoming these difficulties it is suggested that the stripper cows be given some food of a succulent nature which will increase the flow of milk and thus render it less viscous, and that a strong starter of sour milk be used with the cream.

THE CURD TEST IN CHEESE MAKING.

In order that cheese of a uniform standard of excellence may be made the milk supplied to a cheese factory must be of uniformly good quality. "Through carelessness, ignorance, or malice the milk is sometimes delivered to the factory in an imperfect condition. The cheese maker, in order to protect himself as well as the conscientious, painstaking patrons, must be able to accurately judge of the quality of the milk as it is brought to the factory. Especially in those sections where some form of a guarantee principle is in vogue, the cheese maker should possess the latest knowledge as to the best and most accurate methods that have been devised for the determination of the actual value of the raw material."

The Wisconsin Station describes in a recent bulletin[1] a method which enables the cheese maker to determine easily and accurately the cheese-making quality of the milk furnished by each patron. This method has been named the "Wisconsin curd test." The apparatus for this test resembles in some respects the Gerber milk-testing apparatus, and can be obtained of some dealers in dairy supplies. A home-made test, however, can be improvised which will give good results.

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[1] Bul. 67.

HOME-MADE TEST.

The apparatus for the test (see figs. 1 and 2) **consists of a wash tub that is half filled with warm water, a set of pint fruit jars (C) for the different samples, a pipette (P) for measuring the rennet, and a case knife (K) for breaking the curd.**

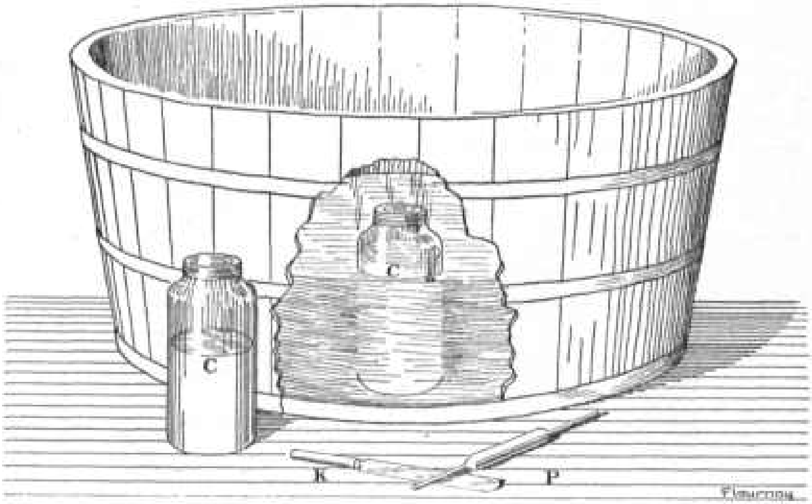

FIG. 1.—The home-made curd test: C, cans used to hold sample; P, pipette for measuring rennet; K, knife for breaking curd.

How to make a test.—To make a test fill a jar half full of milk. Set samples in the tub and fill the same half full of warm water. Usually water at 115° F. will raise the temperature of the milk to the desired point, viz, 98°. If the milk is very cold, care should be taken not to use too hot water, to prevent cracking the ja.

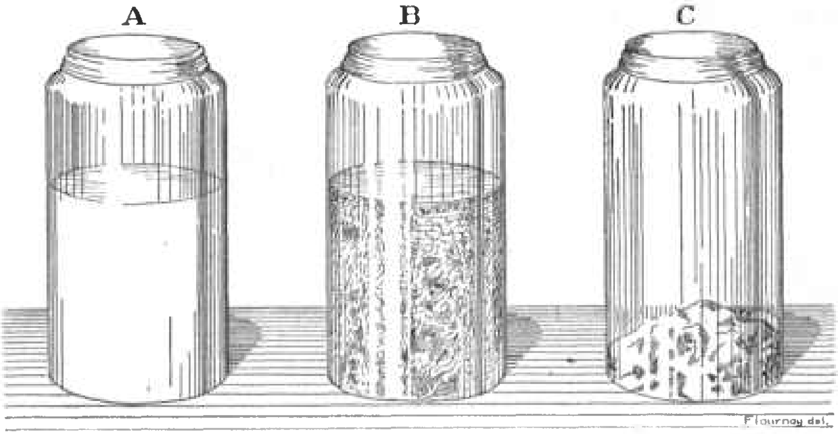

FIG. 2.—Different stages of home-made test: A, milk; B, broken curd in whey; C, matted curd.

When the temperature of the milk reaches 98° F. add to each sample, by means of a pipette, 10 drops of rennet extract and mix thoroughly. Allow the jars to remain undisturbed until milk is curdled, then break the curd into small particles by stirring with a case knife, in order to better expel the whey. In using thermometers for taking temperatures, or knife for cutting the curds, care should be taken to rinse

after using in each sample, so as to prevent the transference of many organisms from one sample to another.

The whey should be poured off as soon as the curd settles to the bottom, this process being repeated at frequent intervals until the curd mats into a solid mass. This expels the excess of whey which contains the fermentable sugar, thereby simulating cheese conditions more closely. The temperature of the surrounding water should be maintained from six to eight hours, to favor a rapid development of the contained organisms.

This improvised apparatus will enable any cheese maker to use the test with satisfactory results, but time can be saved and greater convenience secured if apparatus is devised for the particular purpose in hand. When the curd test is in constant use some such apparatus as that described below will be well worth the expense.

IMPROVED CURD TEST.

The improved apparatus shown in figs. 3 and 4 has the following points of advantage over the improvised test already described:

(1) A water box with a close-fitting cover permits of a retention of the desired temperature for a much longer period of time than an open tub. This is important if the weather is cool.

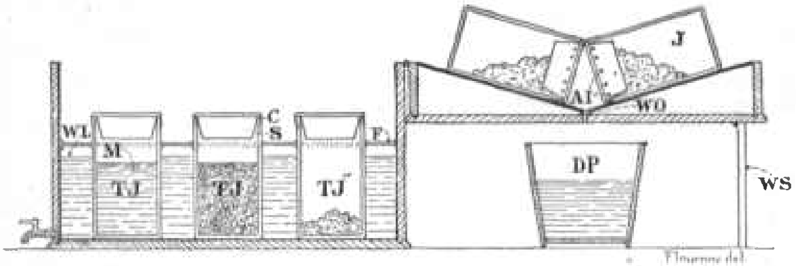

FIG. 3.—Section of improved curd test: TJ, TJ''. test jars showing different stages of test; WL water line; M, milk; F frame; WS, wire standard to support cover; AI, drain holes; WO, whey outlet; DP, drain pail.

(2) A faucet in the bottom allows the water to be drawn off and replaced with warm water without handling the bottles, thereby saving time and labor.

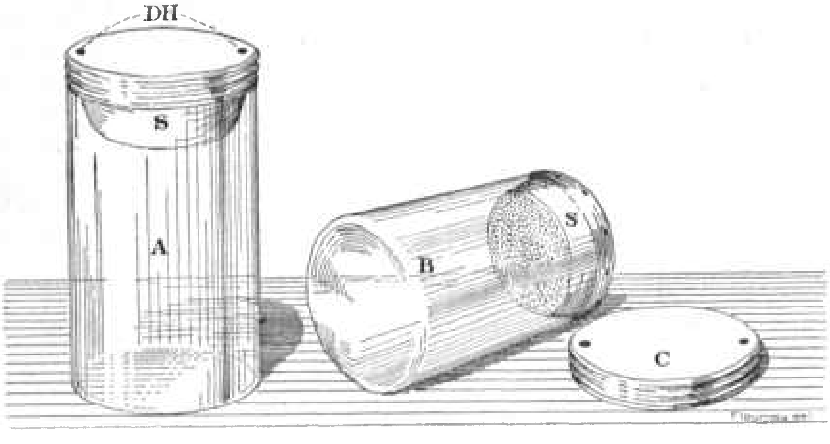

FIG. 4.—Improved test bottle: A, test bottle complete; S, sieve; DH, drain holes in cover; B, test bottle showing construction of cover; C, outer cover; S, sieve.

(3) A rack (F) holds the bottles (T J) in place; without this rack the bottles tip over easily in the water when the whey has been emptied.

(4) The bottles have a large top and straight sides, so that the curd can be more easily removed. The bottles are more easily cleaned on this account.

(5) The strainer (S) in the top enables the operator to place the bottle in an inclined position to let the whey drain out. The whey can thus be more quickly and completely removed. * * *

INTERPRETATION OF RESULTS.

If the milk contains no deleterious bacteria the curd when cut will present a firm, even texture, as shown in fig. 5. If gas-producing bacteria are present the texture of the curd will be more spongy, the cut surface showing a number of holes varying in size, depending upon the prevalence and gas-producing ability of the undesirable bacteria, as shown in figs. 6 and 7.

FIG. 5.—Curd from good milk. Large, irregular holes mechanical.

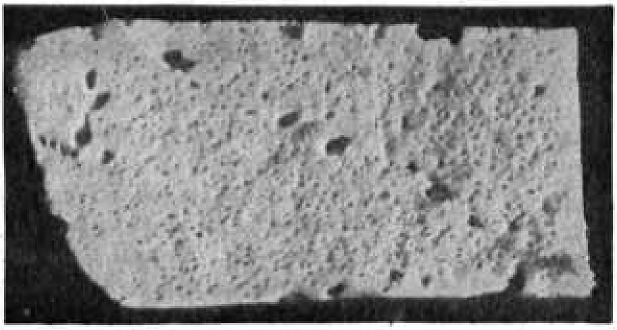

FIG. 6.—Curd from bad milk. Large, irregular holes mechanical, small pin holes due to gas.

FIG. 7.—Floating curd from very bad milk. Condition reached by further development of fig. 6, or a greater number of gas-producing bacteria.

Care should be taken to discriminate between purely mechanical holes that are formed by the failure of the curd to mat closely and those caused by the fermentation of gas. Mechanical holes are irregular in form and more variable in size, while holes formed by gas are circular in outline and more uniformly distributed throughout the whole mass of curd. * * *

It should be borne in mind that the formation of gas is generally accompanied with the production of other decomposition products that possess more or less pronounced undesirable flavors and odors, and that the injury to the cheese is due to this more than to the mere mechanical presence of gas. It is also possible that taints may be produced by bacterial decomposition in cases where no gas is formed. * * * Those bacteria that find their way into the milk through the introduction of filth and dust are particularly prone to produce this change, and this type of fermentation is very often found during the summer months. In the curd test such milks are not condemned upon the texture of the curd, but upon the odor, which is more or less pronounced when the bottles are opened.

This test has been successfully used both at the station and in a number of factories in different parts of Wisconsin and has proved in the hands of the factory operator to be an effective means of detecting tainted milk, and has been "especially useful in helping to solve the controversies that arise in every factory between maker and patrons as to the presence and origin of tainted milks."

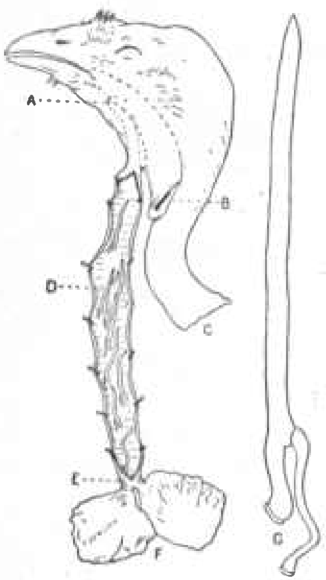

FIG. 8.—Dissection of a chick affected with gapes, the trachea pinned open: A, the glottis or opening through which air enters the trachea from the mouth; B, the cut end of the œsophagus; C, the cut neck; D, the open trachea with gapeworms attached to its wall; E, the bronchial or lung tubes, one for each lung; F, the lungs; G, a pair of gapeworms, the small male being permanently attached to the female.

THE GAPE DISEASE OF CHICKENS.

This common and destructive disease of chickens is due to the presence in the windpipe of the gapeworm, known to scientists as *Syngamus trachealis.* "These worms obstruct the passage of air to and from the lungs (fig. 8), and thus occasion the characteristic gasping movements of the suffering chicks." This disease has been carefully studied by the Kentucky Station. It was found that "the commonly recommended practice of introducing into the trachea a partly stripped feather, or a bluegrass top, and by a twisting motion dislodging and removing the worms does not seem to * * * be practicable for very young chicks. The trachea is so small and so easily injured that it is impossible to dislodge and remove all of the worms by such means. * * * Chicks generally recover without treatment when they are attacked after they are half grown, and hence fowls that might from their size be treated successfully with a feather do not require treatment of any sort. It is the very young chicks that suffer most, and the

only remedial treatment in their case that seems to be successful is rubbing the neck from time to time with lard or vaseline, thoroughly mixed with a little turpentine (three parts of the lard or vaseline to one part of turpentine). This treatment should begin before the disease makes its appearance. It will not help a chick in the last stages of the disease. Pure turpentine will very quickly kill a chick when rubbed on the neck over the trachea."

A French scientist (Megnin) asserts that the use of pounded garlic with the usual food (one garlic bulb to ten birds daily), supplemented by special care in the use of only pure water, which is changed several times a day, has been found to completely eradicate gapes from pheasants. This is a simple treatment, and there is no apparent reason why it should not prove as effective with chickens as with pheasants.

Experiments by the Kentucky Station show that chickens contract the disease when allowed to run on soil which has become infested with the gapeworm or when fed earthworms, and "that keeping chicks on a plank floor for several weeks after they hatch will prevent the gapes. It is [probable] that the same result would be obtained by simply elevating an earthen floor above the surrounding level, so that it would not retain moisture. It must be remembered, though, that after the disease is established in a brood it will be conveyed from one to another through the medium of food and drink, and in such case a plank floor would not alone save it. In case the disease should be introduced by chicks which had contracted it elsewhere, the proper treatment would be to isolate affected individuals as soon as discovered and medicate the drinking water of the rest."

It has been claimed that hens may be infested with the gapeworm without showing any evidence of the fact, and may thus be the means of transmitting the disease to the chicks. If this be true, it becomes important to see that the brood hen is free from the disease before the chicks are hatched.

EXPLANATION OF TERMS.

TERMS USED IN DISCUSSING FERTILIZERS.

Complete fertilizer is one which contains the three essential fertilizing constituents, i. e., nitrogen, phosphoric acid, and potash.

Nitrogen exists in fertilizers in three distinct forms, viz, as organic matter, as ammonia, and as nitrates. It is the most expensive fertilizing ingredient.

Organic nitrogen is nitrogen in combination with other elements either as vegetable or animal matter. The more valuable sources are dried blood, dried meat, tankage, dried fish, and cotton-seed meal.

Ammonia is a compound of nitrogen more readily available to plants than organic nitrogen. The most common form is sulphate of ammonia, or ammonium sulphate. It is one of the first products that results from the decay of vegetable or animal substances.

Nitrates furnish the most readily available forms of nitrogen. The most common are nitrate of soda and nitrate of potash (saltpeter).

Phosphoric acid, one of the essential fertilizing ingredients, is derived from materials called phosphates. It does not exist alone, but in combination, most commonly as phosphate of lime in the form of bones, rock phosphate, and phosphatic slag. Phosphoric acid occurs in fertilizers in three forms—soluble, reverted, and insoluble phosphoric acid.

Superphosphate.—In natural or untreated phosphates the phosphoric acid is insoluble in water and not readily available to plants. Superphosphate is prepared from these by grinding and treating with sulphuric acid, which makes the phosphoric acid more available to plants. Superphosphates are sometimes called acid phosphates.

Potash, as a constituent of fertilizers, exists in a number of forms, but chiefly as chlorid or muriate and as sulphate. All forms are freely soluble in water and are believed to be nearly, if not quite, equally available, but it has been found that the chlorids may injuriously affect the quality of tobacco, potatoes, and certain other crops. The chief sources of potash are the potash salts from Stassfurt, Germany—kainit, sylvinit, muriate of potash, sulphate of potash, and sulphate of potash and magnesia. Wood ashes and cotton-hull ashes are also sources of potash.

TERMS USED IN DISCUSSING FOODS AND FEEDING STUFFS.

Water is contained in all foods and feeding stuffs. The amount varies from 8 to 15 pounds per 100 pounds of such dry materials as hay, straw, or grain to 80 pounds in silage and 90 pounds in some roots.

Dry matter is the portion remaining after removing or excluding the water.

Ash is what is left when the combustible part of a feeding stuff is burned away. It consists chiefly of lime, magnesia, potash, soda, iron, chlorin, and carbonic, sulphuric, and phosphoric acids, and is used largely in making bones. Part of the ash constituents of the food is stored up in the animal's body; the rest is voided in the urine and manure.

Protein (nitrogenous matter) is the name of a group of substances containing nitrogen. Protein furnishes the materials for the lean flesh, blood, skin, muscles, tendons, nerves, hair, horns, wool, casein of milk, albumen of eggs, etc., and is one of the most important constituents of feeding stuffs.

Gluten is the name given to one of the most important of the nitrogenous substances classed together under the general term "protein." "Wheat gum," obtained by carefully chewing wheat, is a familiar example. It is the gluten of flour that gives consistency to the dough.

Carbohydrates.—The nitrogen-free extract and fiber are often classed together under the name of carbohydrates. The carbohydrates form the largest part of all vegetable foods. They are either stored up as fat or burned in the body to produce heat and energy. The most common and important carbohydrates are sugar and starch.

Fiber, sometimes called crude cellulose, is the framework of plants, and is, as a rule, the most indigestible constituent of feeding stuffs. The coarse fodders, such as hay and straw, contain a much larger proportion of fiber than the grains, oil cakes, etc.

Nitrogen-free extract includes starch, sugar, gums, and the like, and forms an important part of all feeding stuffs, but especially of most grains.

Fat, or the materials dissolved from a feeding stuff by ether, is a substance of mixed character, and may include, besides real fats, wax, the green coloring matter of plants, etc. The fat of food is either stored up in the body as fat or burned to furnish heat and energy.

MISCELLANEOUS TERMS.

Micro-organism, or microscopic organism, is a plant or animal too small to be seen without the aid of a compound microscope.

Bacterium (plural, **Bacteria**) is the name applied in common to a number of different or closely related microscopic organisms, all of which consist of single short cylindrical or elliptical cells or two such cells joined end to end and capable of spontaneous movement. Many kinds of bacteria are harmful and cause diseases and other injurious effects, but many are beneficial. Among the latter are those which give aroma to tobacco and flavor to butter and cheese, and those which enable leguminous plants to use the free nitrogen of the air.

Culm.—The stem or straw of grains and grasses.

Node.—That part of the stem (usually somewhat enlarged and hardened, especially in grains and grasses) to which the leaves are attached.

Internode.—The part of the stem between the nodes.

Chlorophyll.—The green coloring matter of plants.

Lactation.—The formation or secretion of milk. The "period of lactation" as applied to cows means the length of time since calving that they have been giving milk.

FARMERS' BULLETINS.

These bulletins are sent free of charge to any address upon application to the Secretary of Agriculture, Washington, D. C. Only the following are available for distribution:

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